ENERGOPTIONS

OVERVIEW PAPER

INSTITUTIONAL SECTOR

Broad Application

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1. INTRODUCTION

Institutions in Canada face rising operating costs and constrained budgets. Energy for space conditioning, domestic hot water and lighting represents a significant component of these operating costs.

Across the country a wide range of institutions have proven the reliability and effectiveness of new energy saving techniques and approaches. Examples include computerized energy management systems and boiler heat recovery devices.

The following projects are successful demonstrations of energy saving technologies. Collectively, the projects illustrate a wide variety of opportunities applicable to institutions. Typically, the various measures offer energy savings in the range of 10% to 40% with payback periods between three and five years.

This paper provides an overview of a number of proven measures, together with documentation of important lessons learned. Suggestions on appropriate next steps and details on resources available are also outlined.

2. OPTIONS

With support from the Federal/Provincial Conservation and Renewable Energy Demonstration Agreements (CREDA) Program, a range of attractive options were demonstrated. Examples follow.

- **Lower Cost Measures**

  - Caulk, seal and weatherstrip (air seal) to reduce heat loss due to infiltration of unconditioned outside air.

- Utilize night setback thermostats and auto exhaust fan "turn-off" when buildings are not in use.

- Remove unnecessary lighting and clean light fixtures on a regular basis.

- Maintain HVAC system in top running order (includes regular cleaning of all air filters).

- Insulate hot water or stream pipe systems.

. **Computerized Energy Monitoring and Management**

- Use a centrally-located computer to monitor and control energy consumption in one or more buildings.

. **Space Heating and Cooling**

- Consider heat pumps, including ground and groundwater source units, for new buildings and for buildings where the existing heating system must be replaced.

- Consider replacing oil-fired boilers with wood residue boilers.

. **Other Options**

- Consider using a small fire-tube boiler as an economizer/heat recovery unit in winter. In summer, this small boiler can efficiently supply the building's reduced energy requirements.

- Install heat recovery devices such as air-to-air heat exchangers in ventilation systems or boiler flue gas heat recovery devices.

- Use a microprocessor demand controller to limit electrical demand costs.

- Consider installing capacitors to improve electrical power factor and reduce electrical costs.

- Increase building shell insulation level in conjunction with building renovation programs.

3. CREDA DEMONSTRATIONS

The CREDA projects outlined below provide a sample of a number of options for reducing energy consumption and costs in institutions. They not only provide tangible evidence of the significant energy cost savings that can be realized in institutions, but also provide practical installation and operation experiences.

The demonstration project Case Studies contained in this Institutional Sector ENEROPTIONS package are:

NB 41 University Energy Efficient Retrofit - Mount Allison University, Sackville, New Brunswick

A comprehensive energy management program was initiated at Mount Allison University including building upgrading, heat recovery, computer control, improved lighting and insulation of steam lines. Comfort levels were greatly improved and annual energy savings were over $157,000 per year.

MAN 39 ENERSCHOOL Retrofit Program

Under this major program, 20 schools were retrofitted and a manual was produced to assist school managers in assessing energy consumption and introducing efficiency measures. The twenty schools received complete energy audits. Major retrofits were undertaken on two schools and minor retrofits on the remainder.

MAN 40 Remote Computerized Energy Management - Manitoba

Energy consumption in the Minnedosa district school system was monitored and controlled using a remote computer hooked up to each school. Over 100 Manitoba school are now in the process of implementing retrofit measures and connecting to remote computers. To date, savings averaging 40% had been realized for both natural gas and electrically-heated buildings.

BC 22 Building Energy Management System - Surrey, British Columbia

Energy use in several buildings is monitored and controlled by one central computer which is linked to the individual buildings by way of leased telephone lines. Payback periods as rapid as 1.3 years have been attained.

ONT 54 Computerized Energy Accounting - Ontario

Hudson's Bay Company used a microcomputer program to monitor monthly energy use in 65 buildings in southern Ontario and to pinpoint inefficient systems and areas of waste. Detailed computer-assisted audits of three buildings identified potential energy savings of over $1 million per year. Hudson's Bay found that the better information and increased management effectiveness alone justified the system.

ONT 47 Water-Source Heat Pumps - Valley East, Ontario

A new recreational complex is heated using water-to-water heat pumps for space and pool heating. The heat pumps extract heat from groundwater drawn from a supply well. This lowers the temperature of the water which is then returned to the aquifer through a discharge well.

ONT 60 Vertical Loop Ground-Source Heat Pump - Toronto, Ontario

Oil-fired boilers in a commercial/industrial facility were replaced with glycol-to-water heat pumps that extract heat from the ground using a series of vertically-buried loops.

NB 54 Wood Residue Fuelled Boiler - University of New Brunswick - Fredericton, New Brunswick

A large wood-fired boiler was installed, under an innovative financing arrangement, at the district heating plan which serves the entire UNB-Fredericton campus, two apartment buildings, and a large 485-bed hospital. Annual operating savings in the range of $820,000 are being realized as the contribution to total heating requirements is over 70%.

ONT 45 Low Temperature Flue Gas Heat Recovery System - Welland, Ontario

John Deere Ltd. installed a Beckett Heat Recovery System which saved the company over $35,000 annually. In the winter, a standard fire-tube boiler is used as an economizer with flue gas being cooled to slightly above the dew point. In summer, or during the "off season", the same unit serves as a compact, economical steam source for the plant's reduced requirements. Similar units are installed in the Welland Hospital and at Carleton University in Ottawa.

ONT 29 Exterior Insulation Retrofit - Kingston, Ontario

A sixteen-storey residence building, the John Orr Tower, at Queen's University, was retrofitted on the exterior with 3 inches of extruded polystyrene insulation and covered by steel cladding in order to reduce heat loss and rectify a water penetration problem. Annual energy savings were about 28%.

Many other projects applicable to the insitutional sector have been undertaken across the country. Contact a government energy office listed on the back of the attached file folder to learn more.

4. LESSONS LEARNED

Low-Cost Measures and General Lessons. Low-cost and no-cost measures can be implemented by operational staff and local contractors without extensive studies. Experience shows that such measures are often cost-effective and required funding can often come from existing operating budgets.

The involvement and commitment of building maintenance staff is an important key to success. These people can usually offer excellent suggestions on low-cost and no-cost measures. Later in the program, when higher cost measures are implemented, maximum savings can be obtained with the dedication and cooperation of maintenance staff in keeping the equipment in top running order.

Since every facility is unique, the services of a qualified in-house energy auditor or experienced engineering consultant are usually required to identify an appropriate program of higher cost retrofit measures.

It is important that the building operation and maintenance staff work closely with the energy auditor during the study phase. Their familiarity with the facility and their suggestions are usually very valuable. Also, their commitment to the measures that are eventually installed is often critical.

Computerized Energy Monitoring and Management. The computerized monitoring and control of energy in the Minnedosa District School System proved so successful that over 100 Manitoba schools are now being put on central computer control systems.

Automated systems are most cost effective (e.g., one year paybacks can be obtained) in the buildings with heavy, yet highly variable use patterns. Such systems are likely not cost-effective for buildings characterized by continuous and consistent use patterns.

Attention should be paid to the quality of the communication link between the central computer and the remote controlled building. Problems in a number of projects were experienced with leased phone lines.

A comprehensive functional specification prepared by a qualified specialist is required for all systems. The preparation of a statement of functional requirements should precede selection of specific hardware and software. The quality of this specification will have an important bearing on the success of the project.

It is usually preferable to have one party take overall responsibility for the entire system. To operate successfully, all hardware, software and communication links must be compatible. When several parties are involved, incompatibility problems can arise and areas of responsibility may become unclear.

Consider using a two-stage tendering process. In the first stage, potential suppliers are invited to submit unpriced technical proposals in response to the functional specification. These proposals can be reviewed, clarifications can be obtained and the functional specifications can be refined to ensure that all bids are directly comparable on a functional basis. In the second stage, a smaller group of qualified bidders can be invited to submit refined price proposals based on the final specification. If a single stage bidding process is used, the technical quality of the proposals may differ widely and the lower priced bids may not represent the best overall value.

The installation of a computer or microprocessor based control system will provide an exciting challenge to some operational staff while others may view it as a threat and possibly even an adversary to be defeated. Skillful employee management is required to ensure that:

a) staff receive the required training,

b) more than one person can program, operate and maintain the system, and

c) suitable action is taken with staff members who are not adjusting to the new technology.

Space Heating and Cooling. Heat pumps can provide much higher efficiencies than other approaches. Their use should be investigated for new buildings or in buildings where the existing heating system must be replaced.

The replacement of an oil-fired boiler with a wood residue boiler can be very attractive in areas with abundant supplies of wood residues. The fuel handling/feed systems to these boilers do require more attention than oil-fired units.

Other Options. Each building must be treated as an integrated system. If a significant sealing or insulation program is undertaken, modifications to the HVAC system will also likely be necessary to ensure indoor air quality and comfort.

Based on the experience gained in 20 Manitoba schools, minor retrofit packages proved much more cost-effective than major retrofit approaches that included higher cost measures.

With low-grade heat recovery from boiler flue gas, maximum recovery is attained by closely controlling the temperature of the flue gas so that it remains close to, but safely above, the dew point.

The application of exterior insulation to an existing building is usually cost-effective only when performed in conjunction with an architectural retrofit of the building. This measure, like the installation of extra roof insulation, generally cannot be justified on the basis of energy savings alone.

When attaching exterior cladding insulation to an existing building, the use of metal channels, drilled holes and serrated nails was found to be less expensive than an approach based on the use of wooden strapping. Further development of the fastening system and improvement in the skills of contractors are required to bring down the cost of this approach.

5. NEXT STEPS

The demonstration case studies contained in this ENEROPTIONS package present some of the options which are applicable in the institutional sector. It is hoped that they will be of benefit by:

- indicating applications that may be relevant to you or your organization

- presenting an accounting of experience--both actual benefits and actual problem areas, if any, that you can expect should you pursue a similar initiative.

To assist you, several "next steps" are suggested below:

- Obtain free copies of the final reports on the projects that are of interest from the addresses indicated at the end of the case studies.

- Contact the appropriate demonstration project manager and/or equipment supplier listed in the case study to obtain further information.

- Establish administrative responsibility for energy management in your organization.

- Undertaken an energy audit to identify the appropriate package of measures for your institution.

- If you lack the necessary in-house engineering resources to identify and implement the appropriate package of measures for your facility, then retain the services of a qualified engineering consultant.

6. RESOURCES AVAILABLE

Free technical reports are available for most of the CREDA projects listed above. Addresses of appropriate contacts for follow-up, including equipment suppliers and system designers, are listed at the end of each of the attached ENEROPTIONS Case Studies under the "Further Information" section.

Manuals on the energy efficient retrofit of schools, hospitals and arenas are available from:

ENEROPTIONS
Energy Information Centre
Manitoba Energy and Mines
117-234 Donald Street
Winnipeg, Manitoba
R3C 3M8
(204) 945-4154

The departments or ministries of energy in each province or territory have information on energy conservation and alternative energy and may have assistance programs. Check your telephone directory for appropriate contact people.

The Conservation and Renewable Energy Offices (CREOs) of Energy, Mines and Resources Canada in each province and territory have information on federal demonstrations, and other assistance programs. Check the back of the attached file folder for the office in your area.

Energy audit services are also available from qualified engineering firms. Information on these firms and the "Recommended Procedure for the Selection of an Engineer to Provide Professional Services" can be obtained from:

a) The Association of Consulting Engineers of Canada
(Re: ENEROPTIONS)
Suite 616
130 Albert Street
Ottawa, Ontario
K1P 5G4
(613) 236-0569

b) The consulting engineering organization in each province.

Information on innovative financing arrangements can be obtained through the government departments listed above and/or by contacting:

Martin Adelaar
(Re: ENEROPTIONS)
Energy Management Advisor
Energy Conservation and Oil Substitution Branch
Energy, Mines and Resources Canada
580 Booth Street
Ottawa, Ontario
K1A 0E4
(613) 995-1118